The Effect of Adding Palm Shell Ash on Soil Shear Strength

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ABSTRACT

The soil in Tanjung Rejo Village, Percut Sei Tuan, Deli Serdang, is characterized by fine-grained clay with low stability. To stability, this study focuses on soil stabilization using palm shell ash mixtures at varying percentages (0%, 4%, 6%, 8%, 10%, and 12%) at optimum moisture conditions. Stabilization involves mixing the clayey soil with additional materials to improve its technical properties, specifically employing palm kernel shell ash. Testing was conducted following ASTM methods. As the percentage of palm shell ash in the mixture increased, both cohesion and friction angle values showed an increasing trend, reaching optimal values at 10% palm shell ash. The Direct Shear test on native soil yielded a cohesion of 10.3 KPa and a shear angle of 14.6°, whereas the most optimum values for cohesion (14.1 KPa) and friction angle (24.60°) were observed in the soil mixture with 10% palm shell ash variation.

Keywords: Palm shell ash, direct shear, clay soil.

1. INTRODUCTION

Soil condition at each location is one of the important aspects in the world of civil engineering because soil is a natural material that is very complex and varied. [1]. Soil has role in civil construction, both as a component of construction materials and as a physical support for the building itself, which depends on its ability to support the loads generated by the construction above carefully and detailed study is needed. [2]

This research was conducted on clay soil found in Tanjung Rejo Village, Percut Sei Tuan Subdistrict, Deli Serdang Regency which will undergo stabilization with the addition of palm kernel shell ash. This process aims to improve the physical and mechanical properties of the soil that were initially less than ideal for a better state. [3]. Stabilized or soil improvement measures are often to increase the strength and bearing capacity of the soil during road construction. The research specifically on used of palm kernel shell ash in the stabilization process of clay soil and aims to measure the shear stress, cohesion value and shear angle of the stabilized soil.[4]

Therefore, the problem formulation discuss in this research is the effect of changes in soil physical properties after addition of palm kernel shell ash and the effect of the ratio of palm shell ash mixture on the increase in direct shear strength by Direct Shear Test in the laboratory. [2]. This study aims to determine the extent to which the addition of palm kernel shell ash can optimize the shear strength of clay soils that will be test. The Using Direct Shear tool in the laboratory. In addition, this study will also provide an overview of the soil type and properties on the Percut Sei Tuan Village road through relevant soil physical analysis.[5]

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2. EXPERIMENTAL PROCEDURE

The research methodology started with the soil sampling stage, the followed by the analysis of chemical elements conducted at the Physics Laboratory of Medan State University. Simultaneously, the physical and mechanical properties of the soil tested, including the Direct Shear Test. The experiment involved various variations of palm shell ash mixture, namely 0%, 4%, 6%, 8%, 10%, and 12% of the weight of the soil sample that was the object of the test. All test procedures refer to the standards set by ASTM (Annual Book of ASTM Standards). The results of tests are present in the form of tables and graphs, which are then analyzed in depth to draw conclusions.[6]

3. RESULTS AND DISCUSSION

Mixing reactive palm shell ash solid waste with clay soil forms clumps of clay soil particles and makes the clay soil particles larger, has a rough texture and non-cohesive nature can affect segregation, thereby increasing the shear strength of clay soil.

The research results on the direct shear test can be seen in the following Table 1 and Figure 1-3.

Table 1 Correlation of PSA with C, φ and Shear Stress

PSA	Cohesion (C)	Friction angle (φ)	Shear Stress
(%)	KPA	(^{0})	KPA
0	10,3	14,6	18
4	9,7	22,1	22
6	10,8	24,6	25
8	13,5	23,6	26
10	14,1	24,60	28
12	15,4	22,60	28

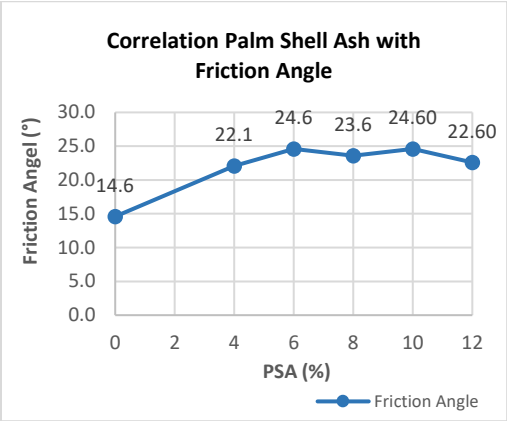

Figure 1. Correlation Palm Shell Ash with Friction Angle.

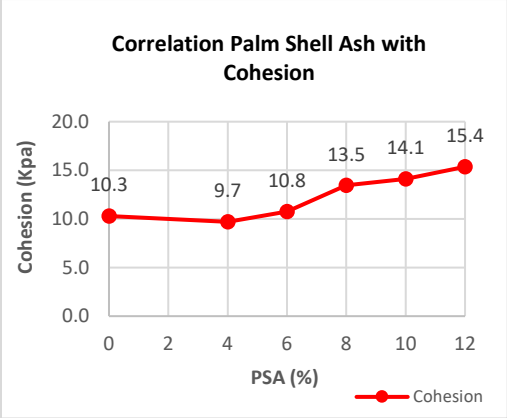

Figure 2. Correlation Palm Shell Ash with Cohesion.

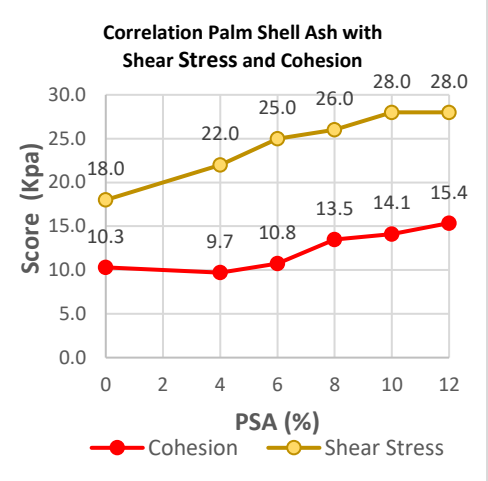

Figure 3. Correlation Palm Shell Ash with Shear Stress and Cohesion.

4. CONCLUSION

Based on the results of observations and data analysis of original soil samples and mixtures with palm shell ash (0%, 4%, 6%, 8%, 10%, 12%), the main conclusions are as follows: Direct Shear test results on original soil show The cohesion value is 10.3 KPa and the friction angle is 14.6°, while in mixed soil the optimum cohesion value and friction angle are achieved with a 10% variation of palm shell ash, namely 14.1 KPa and 24.60°. From the results of this test, it can be concluded that the palm shell ash mixture has good potential for use in road pavement in Tanjung Rejo Village, Percut Sei Tuan, Deli Serdang, North Sumatra, Indonesia

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